TITLE: MODULAR PATH PLANNER
INVENTOR: Sarah Ann Gray, et. al.
DOCKET #: 16436 /deb, mah

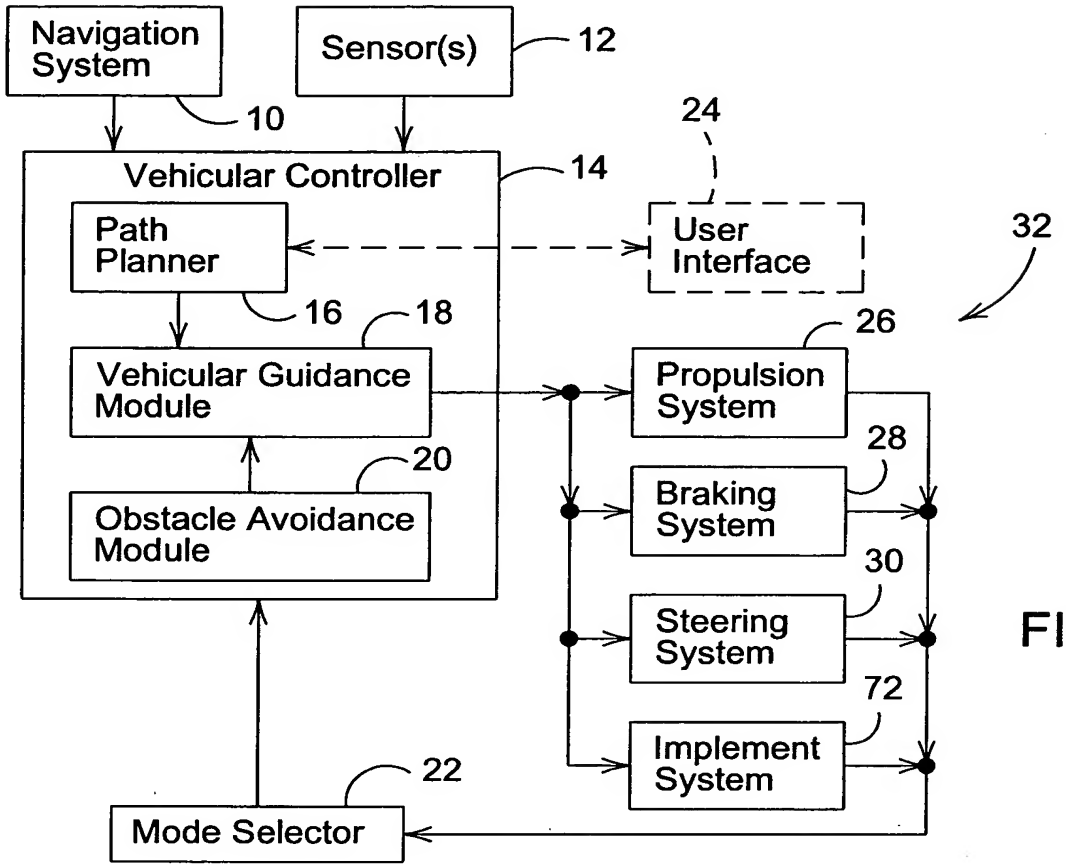

FIG. 1

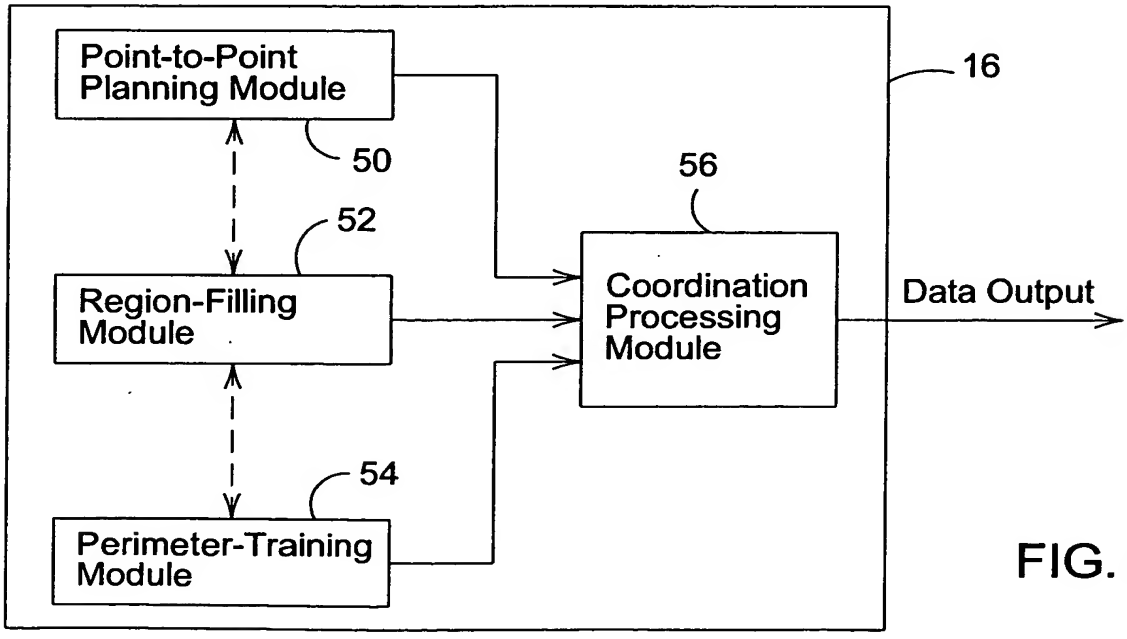

FIG. 2

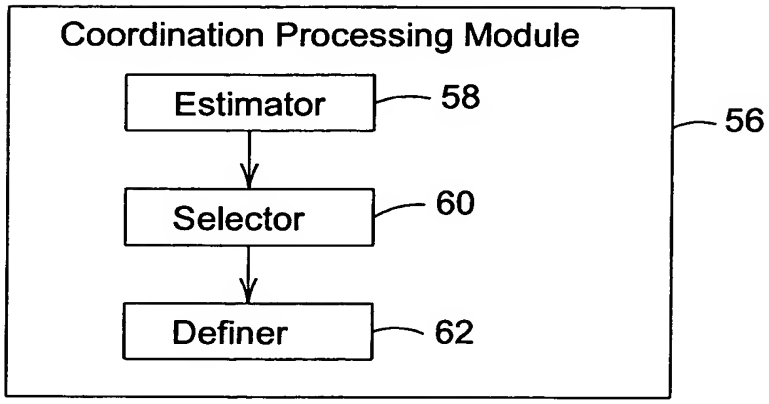
Coordination Processing Module
Estimator
58
Selector
60
Definer
62
56

FIG. 3

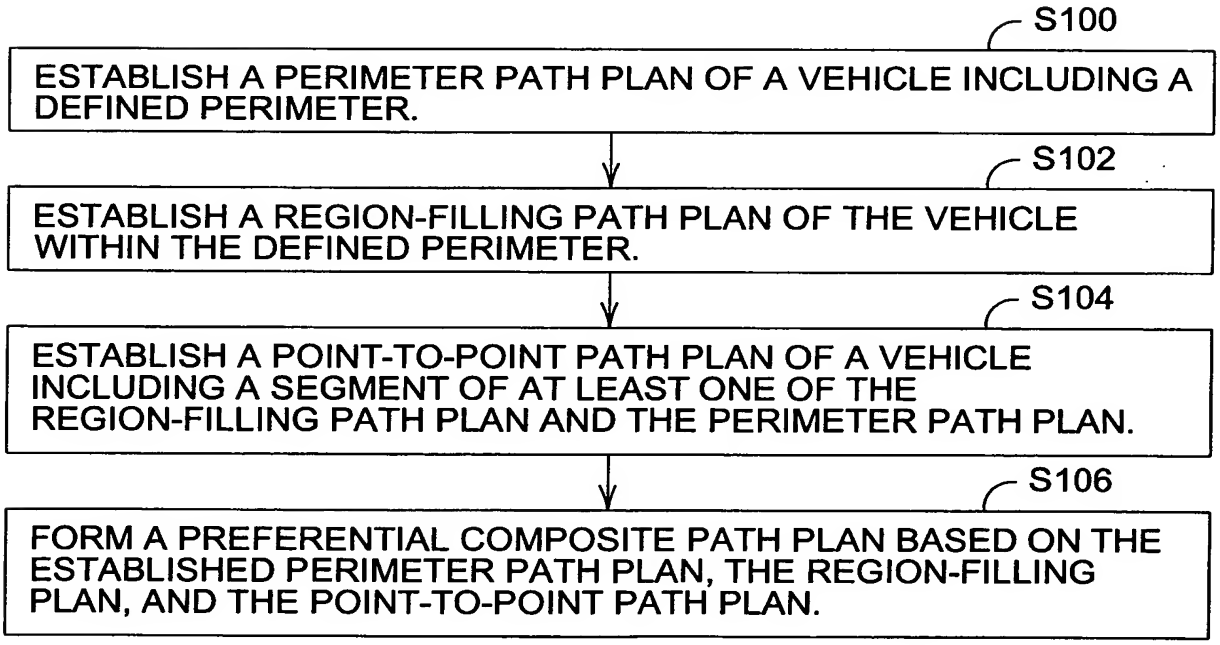
S100
ESTABLISH A PERIMETER PATH PLAN OF A VEHICLE INCLUDING A DEFINED PERIMETER.
S102
ESTABLISH A REGION-FILLING PATH PLAN OF THE VEHICLE WITHIN THE DEFINED PERIMETER.
S104
ESTABLISH A POINT-TO-POINT PATH PLAN OF A VEHICLE INCLUDING A SEGMENT OF AT LEAST ONE OF THE REGION-FILLING PATH PLAN AND THE PERIMETER PATH PLAN.
S106
FORM A PREFERENTIAL COMPOSITE PATH PLAN BASED ON THE ESTABLISHED PERIMETER PATH PLAN, THE REGION-FILLING PLAN, AND THE POINT-TO-POINT PATH PLAN.

FIG. 4

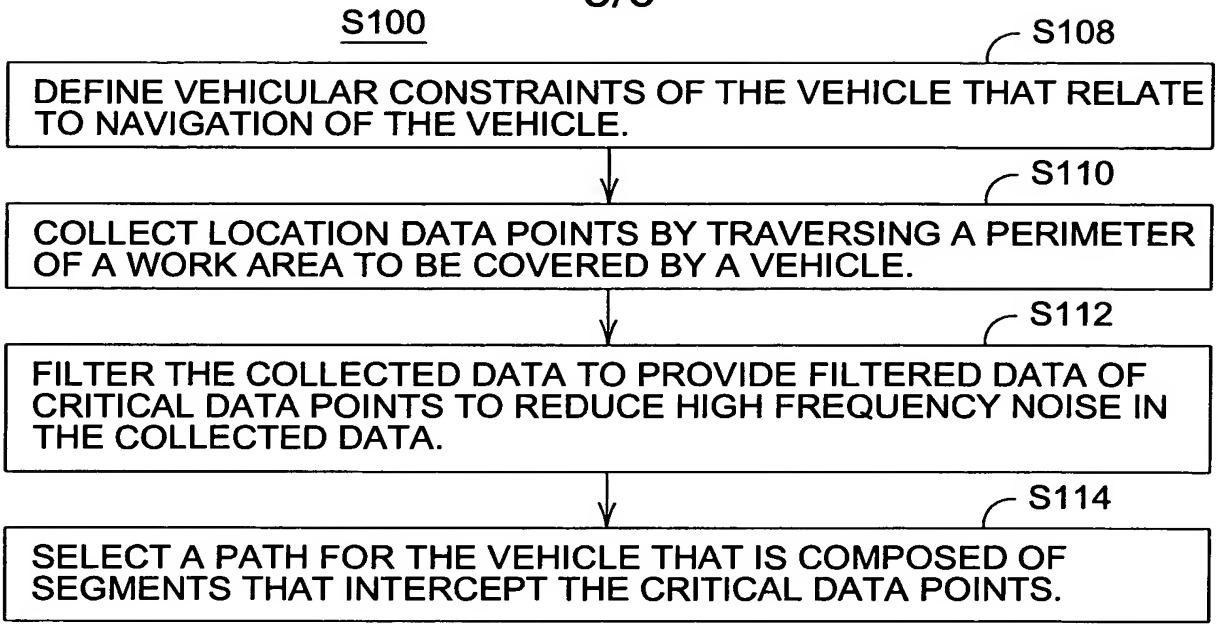
S100
S108
DEFINE VEHICULAR CONSTRAINTS OF THE VEHICLE THAT RELATE TO NAVIGATION OF THE VEHICLE.
S110
COLLECT LOCATION DATA POINTS BY TRAVERSING A PERIMETER OF A WORK AREA TO BE COVERED BY A VEHICLE.
S112
FILTER THE COLLECTED DATA TO PROVIDE FILTERED DATA OF CRITICAL DATA POINTS TO REDUCE HIGH FREQUENCY NOISE IN THE COLLECTED DATA.
S114
SELECT A PATH FOR THE VEHICLE THAT IS COMPOSED OF SEGMENTS THAT INTERCEPT THE CRITICAL DATA POINTS.

FIG. 5

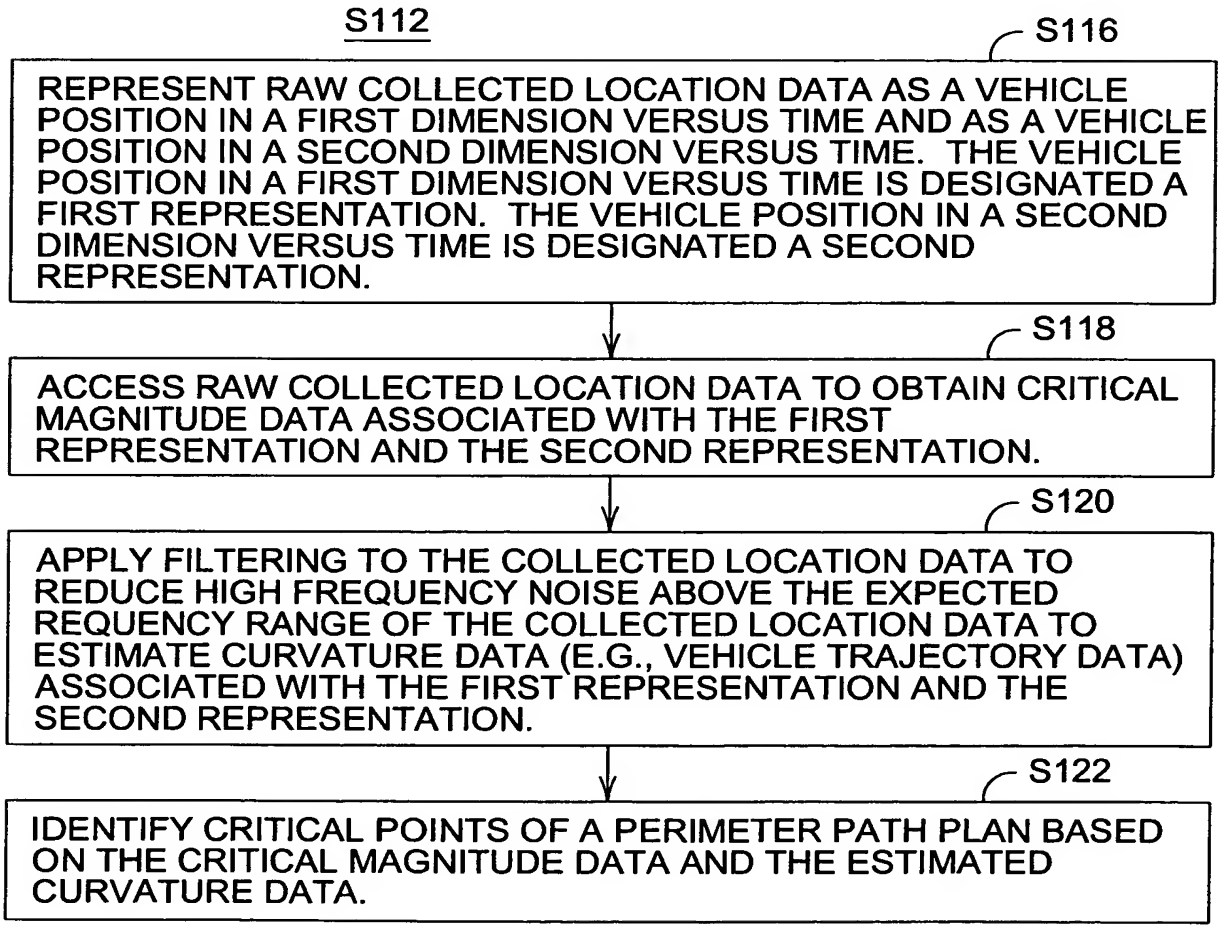
S112
S116
REPRESENT RAW COLLECTED LOCATION DATA AS A VEHICLE POSITION IN A FIRST DIMENSION VERSUS TIME AND AS A VEHICLE POSITION IN A SECOND DIMENSION VERSUS TIME. THE VEHICLE POSITION IN A FIRST DIMENSION VERSUS TIME IS DESIGNATED A FIRST REPRESENTATION. THE VEHICLE POSITION IN A SECOND DIMENSION VERSUS TIME IS DESIGNATED A SECOND REPRESENTATION.
S118
ACCESS RAW COLLECTED LOCATION DATA TO OBTAIN CRITICAL MAGNITUDE DATA ASSOCIATED WITH THE FIRST REPRESENTATION AND THE SECOND REPRESENTATION.
S120
APPLY FILTERING TO THE COLLECTED LOCATION DATA TO REDUCE HIGH FREQUENCY NOISE ABOVE THE EXPECTED REQUENCY RANGE OF THE COLLECTED LOCATION DATA TO ESTIMATE CURVATURE DATA (E.G., VEHICLE TRAJECTORY DATA) ASSOCIATED WITH THE FIRST REPRESENTATION AND THE SECOND REPRESENTATION.
S122
IDENTIFY CRITICAL POINTS OF A PERIMETER PATH PLAN BASED ON THE CRITICAL MAGNITUDE DATA AND THE ESTIMATED CURVATURE DATA.

FIG. 6

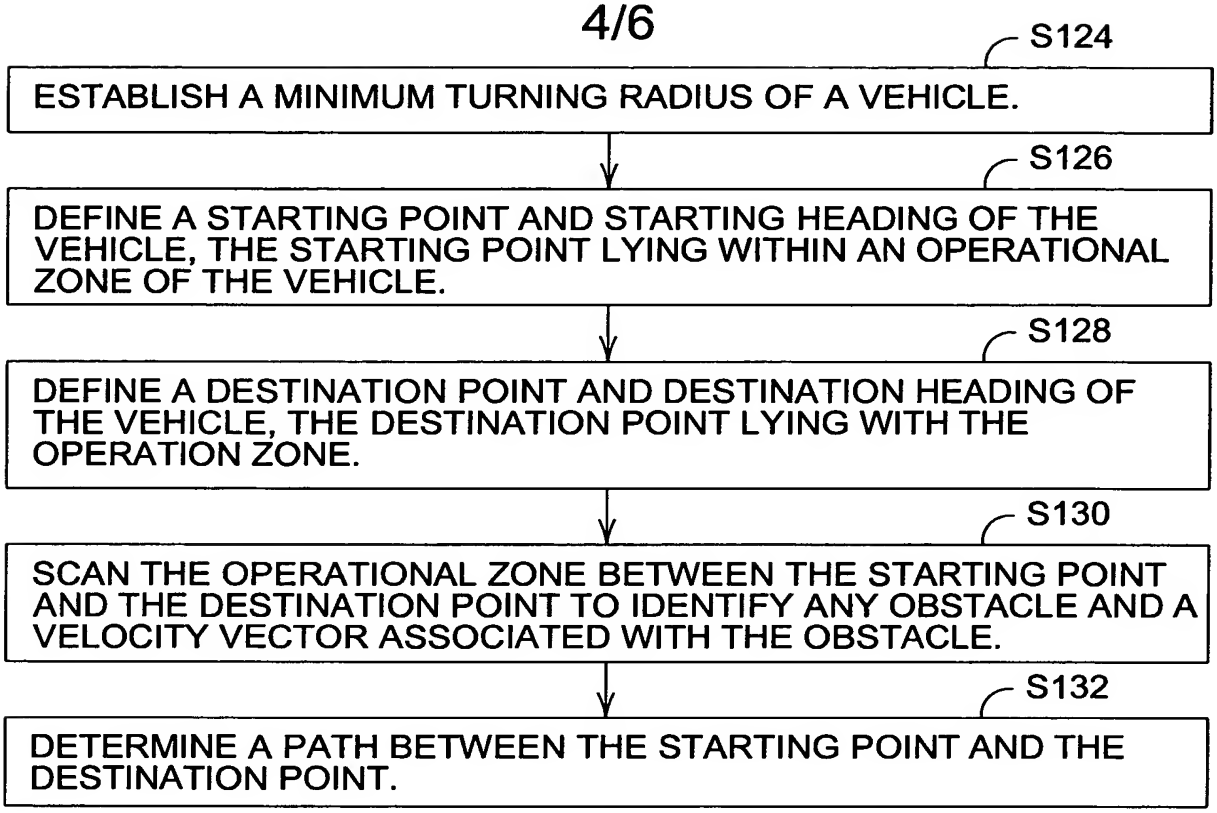
S124
ESTABLISH A MINIMUM TURNING RADIUS OF A VEHICLE.
S126
DEFINE A STARTING POINT AND STARTING HEADING OF THE VEHICLE, THE STARTING POINT LYING WITHIN AN OPERATIONAL ZONE OF THE VEHICLE.
S128
DEFINE A DESTINATION POINT AND DESTINATION HEADING OF THE VEHICLE, THE DESTINATION POINT LYING WITH THE OPERATION ZONE.
S130
SCAN THE OPERATIONAL ZONE BETWEEN THE STARTING POINT AND THE DESTINATION POINT TO IDENTIFY ANY OBSTACLE AND A VELOCITY VECTOR ASSOCIATED WITH THE OBSTACLE.
S132
DETERMINE A PATH BETWEEN THE STARTING POINT AND THE DESTINATION POINT.

FIG. 7

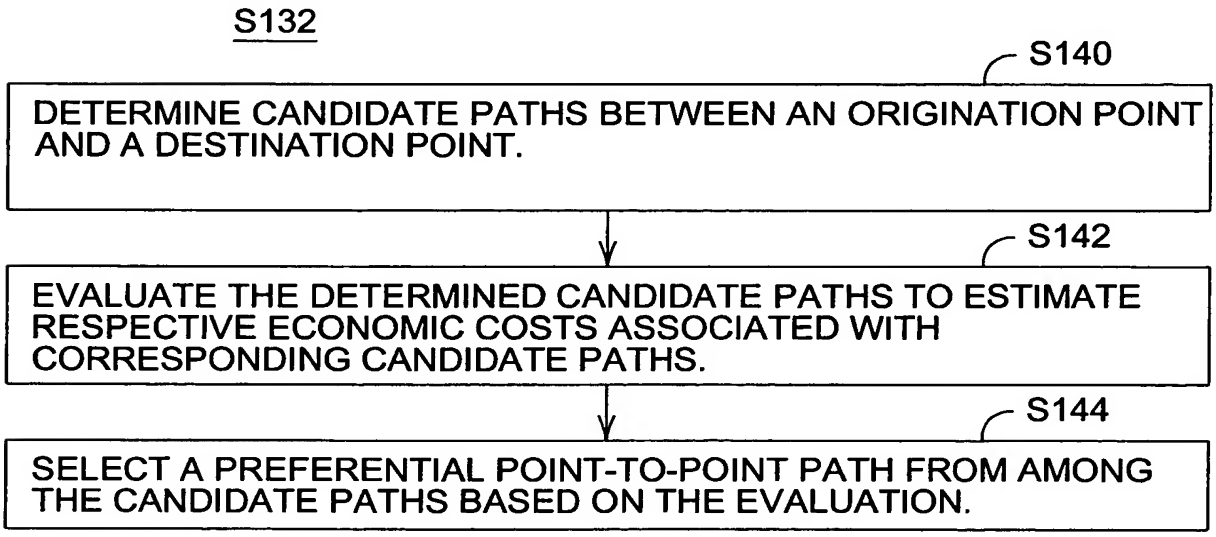
S132
S140
DETERMINE CANDIDATE PATHS BETWEEN AN ORIGINATION POINT AND A DESTINATION POINT.
S142
EVALUATE THE DETERMINED CANDIDATE PATHS TO ESTIMATE RESPECTIVE ECONOMIC COSTS ASSOCIATED WITH CORRESPONDING CANDIDATE PATHS.
S144
SELECT A PREFERENTIAL POINT-TO-POINT PATH FROM AMONG THE CANDIDATE PATHS BASED ON THE EVALUATION.

FIG. 8

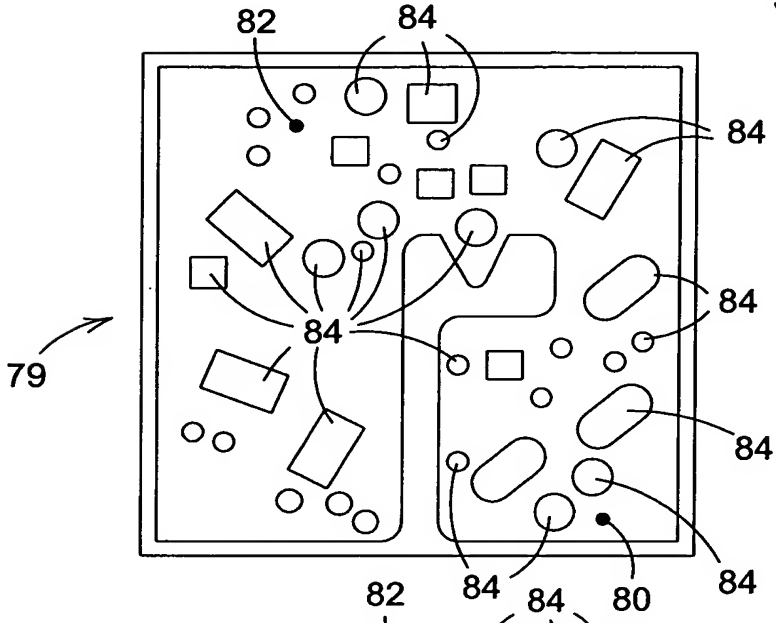

FIG. 9A

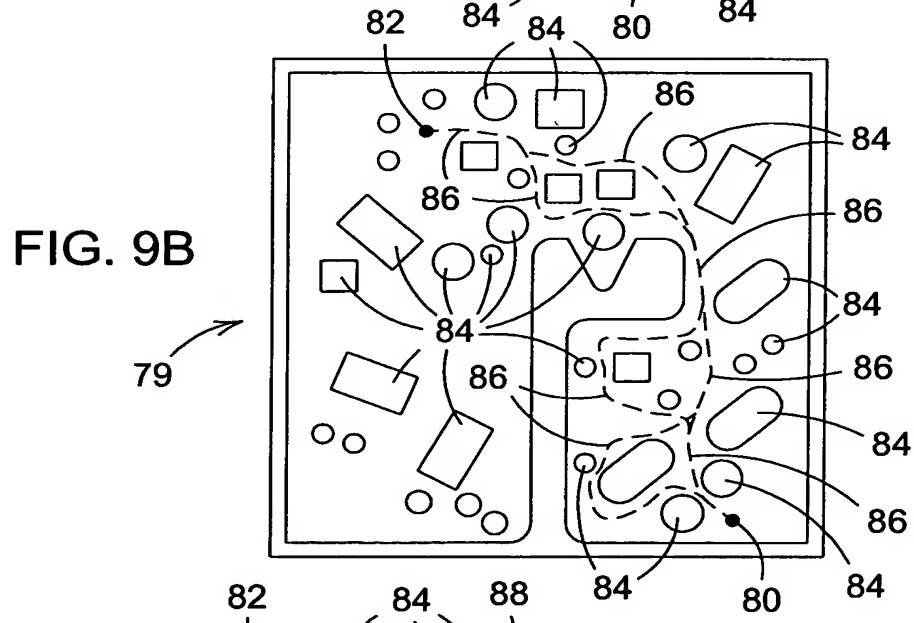

FIG. 9B

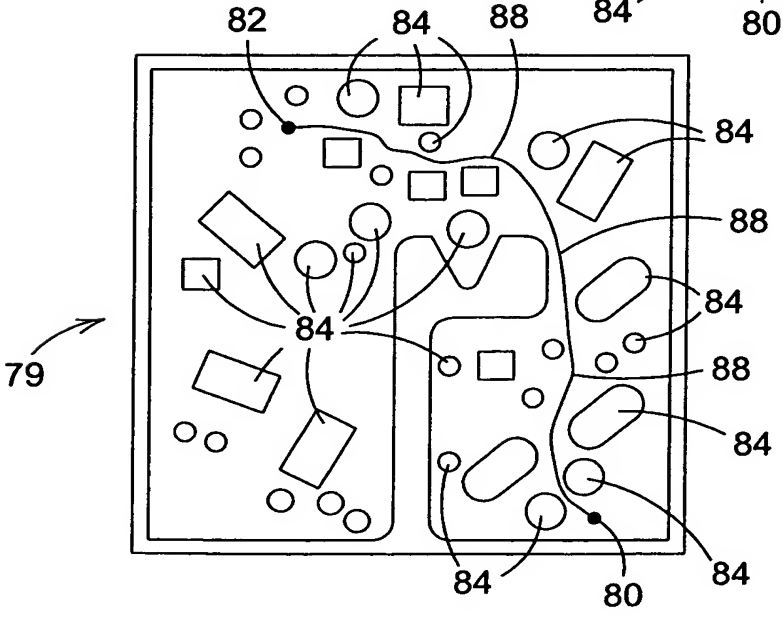

FIG. 9C

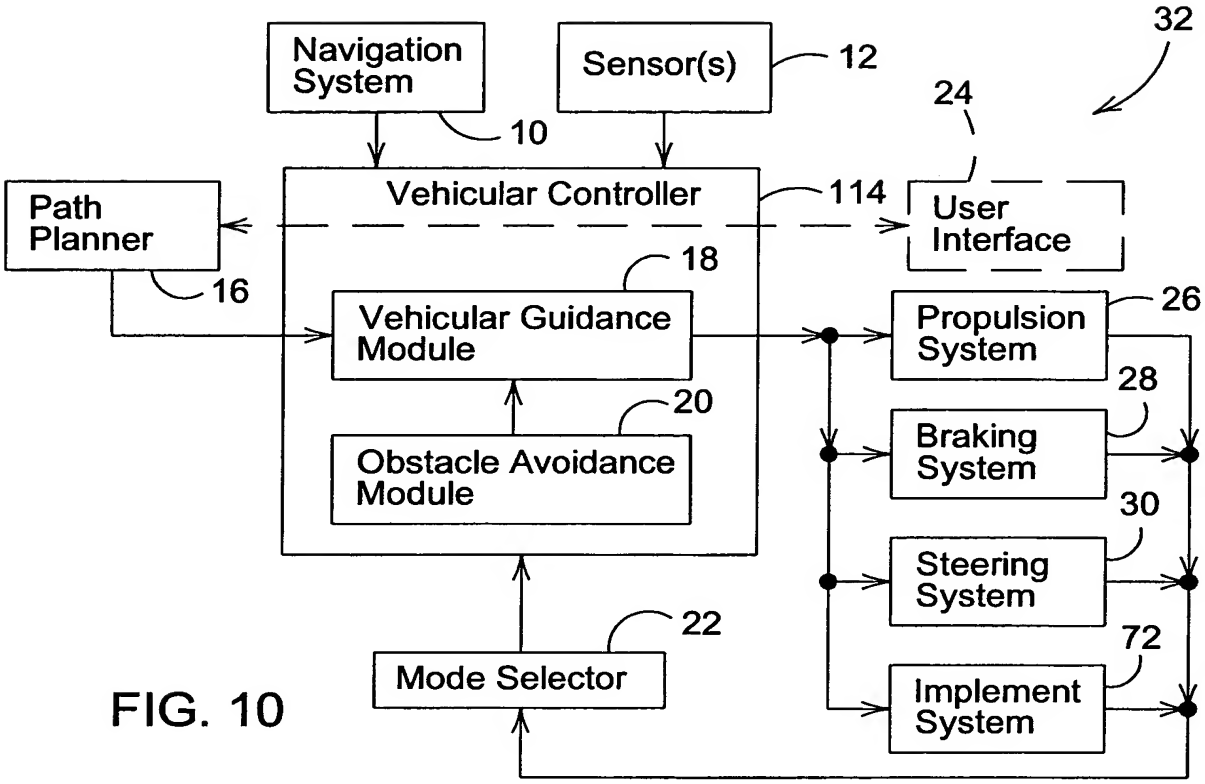
Navigation System
Sensor(s)
12
32
24
10
Vehicular Controller
114
User Interface
Path Planner
16
18
Vehicular Guidance Module
26
Propulsion System
28
20
Braking System
Obstacle Avoidance Module
30
Steering System
22
72
Mode Selector
Implement System

FIG. 10